5COSC005W MOBILE APPLICATION DEVELOPMENT
Lecture 3: Activities and Intents

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Activities and Intents

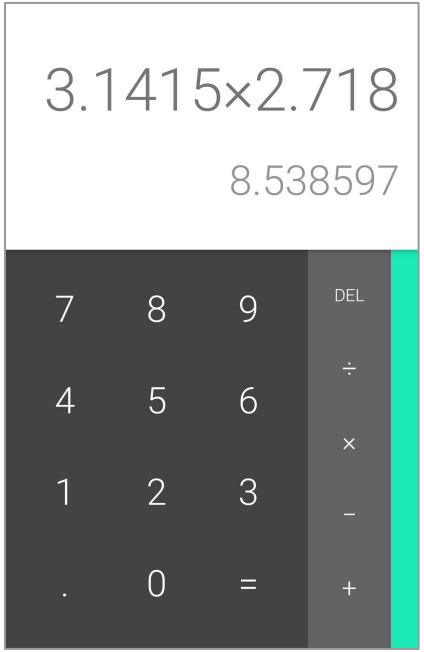
What is an Activity?

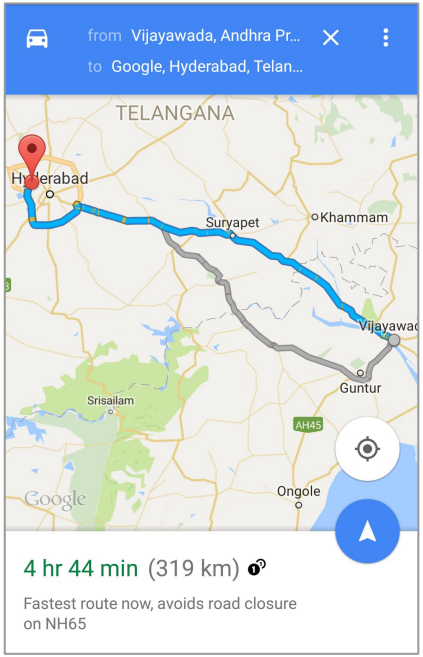
- An `Activity` is an application component
- Represents one window, one hierarchy of views
- Typically fills the screen, but can be embedded in other Activity or a appear as floating window
- Java class, typically one Activity in one file

What does an Activity do?

- Represents an activity, such as ordering groceries, sending email, or getting directions
- Handles user interactions, such as button clicks, text entry, or login verification
- Can start other activities in the same or other apps
- Has a life cycle—is created, started, runs, is paused, resumed, stopped, and destroyed

Examples of activities





Apps and activities

- Activities are loosely tied together to make up an app
- First Activity user sees is typically called "main activity"
- Activities can be organized in parent-child relationships in the Android manifest to aid navigation

Layouts and Activities

- An `Activity` typically has a UI layout
- Layout is usually defined in one or more XML files
- `Activity` "inflates" layout as part of being created

Implementing Activities

Implement new activities

1. Define layout in XML
2. Define `Activity` Java class
    - extends `AppCompatActivity`
3. Connect `Activity` with Layout
    - Set content view in `onCreate()`
4. Declare `Activity` in the Android manifest

1. Define layout in XML

```
<?xml version="1.0" encoding="utf-8"?>
<RelativeLayout
    xmlns:android="http://schemas.android.com/apk/res/android"
    android:layout_width="match_parent"
    android:layout_height="match_parent">
    <TextView
        android:layout_width="wrap_content"
        android:layout_height="wrap_content"
        android:text="Let's Shop for Food!" />
</RelativeLayout>
```

2. Define Activity Java class

```
public class MainActivity extends AppCompatActivity {
    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
    }
}
```

3. Connect activity with layout

```
public class MainActivity extends AppCompatActivity {
    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_main);
    }
}
```

Resource is layout in this XML file

4. Declare activity in Android manifest

```
<activity android:name=".MainActivity">
```

4. Declare main activity in manifest

`MainActivity` needs to include `intent-filter` to start from launcher

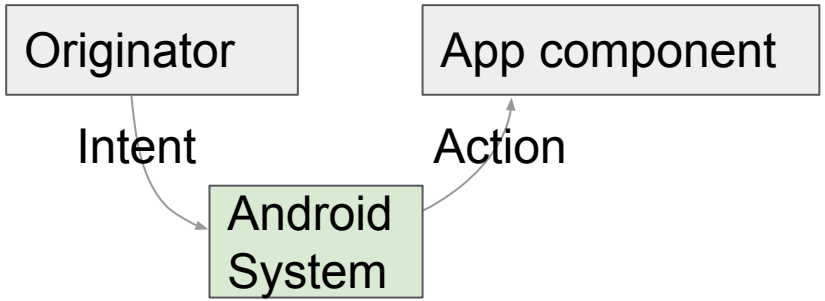
```
<activity android:name=".MainActivity">
    <intent-filter>
        <action android:name="android.intent.action.MAIN" />
        <category android:name="android.intent.category.LAUNCHER" />
    </intent-filter>
</activity>
```

Intents

What is an Intent?

An `Intent` is a description of an operation to be performed.

An `Intent` is an object used to request an action from another app component via the Android system.



What can intents do?

- Start an `Activity`
  - A button click starts a new `Activity` for text entry
  - Clicking Share opens an app that allows you to post a photo
- Start an `Service`
  - Initiate downloading a file in the background
- Deliver `Broadcast`
  - The system informs everybody that the phone is now charging

Explicit and implicit intents

Explicit Intent

- Starts a specific `Activity`
  - Request tea with milk delivered by Nikita
  - Main activity starts the `ViewShoppingCart Activity`

Implicit Intent

- Asks system to find an `Activity` that can handle this request
  - Find an open store that sells green tea
  - Clicking Share opens a chooser with a list of apps

Starting Activities

Start an Activity with an explicit intent

To start a specific `Activity`, use an explicit `Intent`

1. Create an `Intent`
   - `Intent intent = new Intent(this, ActivityName.class);`
2. Use the `Intent` to start the `Activity`
   - `startActivity(intent);`

Start an Activity with implicit intent

To ask Android to find an `Activity` to handle your request, use an implicit `Intent`

1. Create an `Intent`
   - `Intent intent = new Intent(action, uri);`
2. Use the `Intent` to start the `Activity`
   - `startActivity(intent);`

Implicit Intents - Examples

Show a web page

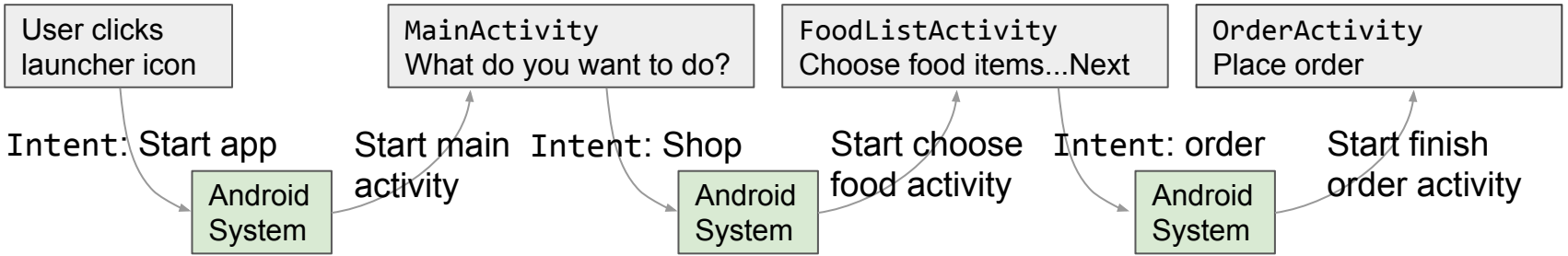
```
Uri uri = Uri.parse("http://www.google.com");
Intent it = new Intent(Intent.ACTION_VIEW,uri);
startActivity(it);
```

Dial a phone number

```
Uri uri = Uri.parse("tel:8005551234");
Intent it = new Intent(Intent.ACTION_DIAL, uri);
startActivity(it);
```

How Activities Run

- All `Activity` instances are managed by the Android runtime
- Started by an "`Intent`", a message to the Android runtime to run an activity



Sending and Receiving Data

Two types of sending data with intents

- Data—one piece of information whose data location can be represented by an URI

- Extras—one or more pieces of information as a collection of key-value pairs in a `Bundle`

Sending and retrieving data

In the first (sending) `Activity`:

1. Create the `Intent` object
2. Put data or extras into that `Intent`
3. Start the new `Activity` with `startActivity()`

In the second (receiving) `Activity`:

1. Get the `Intent` object, the `Activity` was started with
2. Retrieve the data or extras from the `Intent` object

Putting a URI as intent data

```
// A web page URL
intent.setData(
    Uri.parse("http://www.google.com"));

// a Sample file URI
intent.setData(
     Uri.fromFile(new
File("/sdcard/sample.jpg")));
```

Put information into intent extras

- `putExtra(String name, int value)`
  ⇒ `intent.putExtra("level", 406);`
- `putExtra(String name, String[] value)`
  ⇒
```
String[] foodList = {"Rice", "Beans", "Fruit"};
intent.putExtra("food", foodList);
```
- `putExtras(bundle);`
  ⇒ if lots of data, first create a bundle and pass the bundle.
- See documentation for all

Sending data to an activity with extras

```
public static final String EXTRA_MESSAGE_KEY =
    "com.example.android.twoactivities.extra.MESSAGE";

Intent intent = new Intent(this,
SecondActivity.class);

String message = "Hello Activity!";

intent.putExtra(EXTRA_MESSAGE_KEY, message);

startActivity(intent);
```

Get data from intents

- `getData();`
  `⇒ Uri locationUri = intent.getData();`
- `int getIntExtra (String name, int defaultValue)`
  `⇒ int level = intent.getIntExtra("level", 0);`
- `Bundle bundle = intent.getExtras();`
  ⇒ Get all the data at once as a bundle.
- See documentation for all

Returning data to the starting activity

1. Use `startActivityForResult()` to start the second `Activity`
2. To return data from the second `Activity`:
   - Create a ***new*** `Intent`
   - Put the response data in the `Intent` using `putExtra()`
   - Set the result to `Activity.RESULT_OK` or `RESULT_CANCELED`, if the user cancelled out
   - call `finish()` to close the `Activity`
3. Implement `onActivityResult()` in first `Activity`

startActivityForResult()

`startActivityForResult(intent, requestCode);`

- Starts `Activity` (`intent`), assigns it identifier (`requestCode`)
- Returns data via `Intent` extras
- When done, pop stack, return to previous `Activity`, and execute on`ActivityResult()` callback to process returned data
- Use `requestCode` to identify which `Activity` has "returned"

1. startActivityForResult() Example

```
public static final int CHOOSE_FOOD_REQUEST = 1;

Intent intent = new Intent(this, ChooseFoodItemsActivity.class);
startActivityForResult(intent, CHOOSE_FOOD_REQUEST);
```

2. Return data and finish second activity

```
 // Create an intent
Intent replyIntent = new Intent();

// Put the data to return into the extra
replyIntent.putExtra(EXTRA_REPLY, reply);

// Set the activity's result to RESULT_OK
setResult(RESULT_OK, replyIntent);

// Finish the current activity
finish();
```

3. Implement onActivityResult()

```
public void onActivityResult(int requestCode,
                             int resultCode, Intent data) {
  super.onActivityResult(requestCode, resultCode, data);
  if (requestCode == CHOOSE_FOOD_REQUEST) { // Identify activity
    if (resultCode == RESULT_OK) { // Activity succeeded
      String reply =
data.getStringExtra(SecondActivity.EXTRA_REPLY);
      // ... do something with the data
 }}}
```

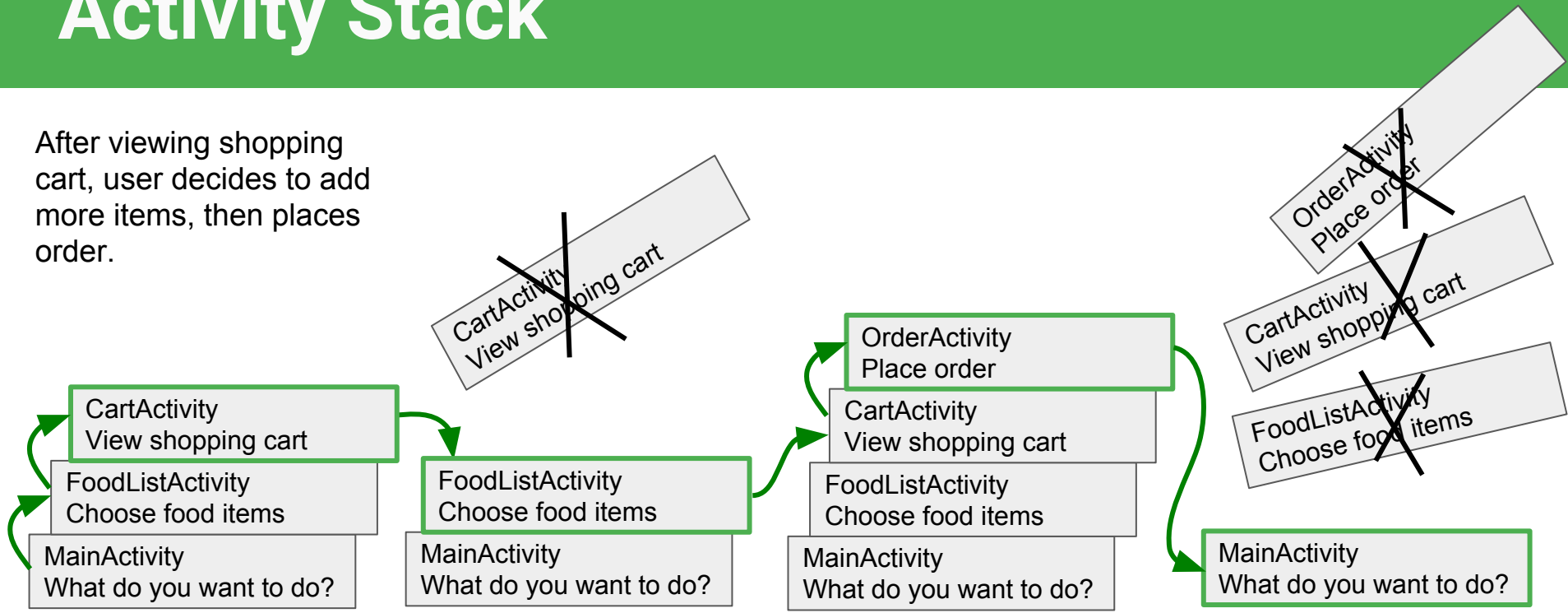
Navigation

Activity stack

- When a new `Activity` is started, the previous `Activity` is stopped and pushed on the `Activity` back stack
- Last-in-first-out-stack—when the current `Activity` ends, or the user presses the Back button, it is popped from the stack and the previous `Activity` resumes

Activity Stack

After viewing shopping cart, user decides to add more items, then places order.



Two forms of navigation

Temporal or back navigation

- provided by the device's Back button
- controlled by the Android system's back stack

Ancestral or up navigation

- provided by the Up button in app's action bar
- controlled by defining parent-child relationships between activities in the Android manifest

Back navigation

- Back stack preserves history of recently viewed screens
- Back stack contains all the `Activity` instances that have been launched by the user in reverse order *for the current task*
- Each task has its own back stack
- Switching between tasks activates that task's back stack

Up navigation

- Goes to parent of current `Activity`
- Define an `Activity` parent in Android manifest
- Set `parentActivityName`

```
<activity
    android:name=".ShowDinnerActivity"
    android:parentActivityName=".MainActivity" >
</activity>
```

Activity lifecycle and state

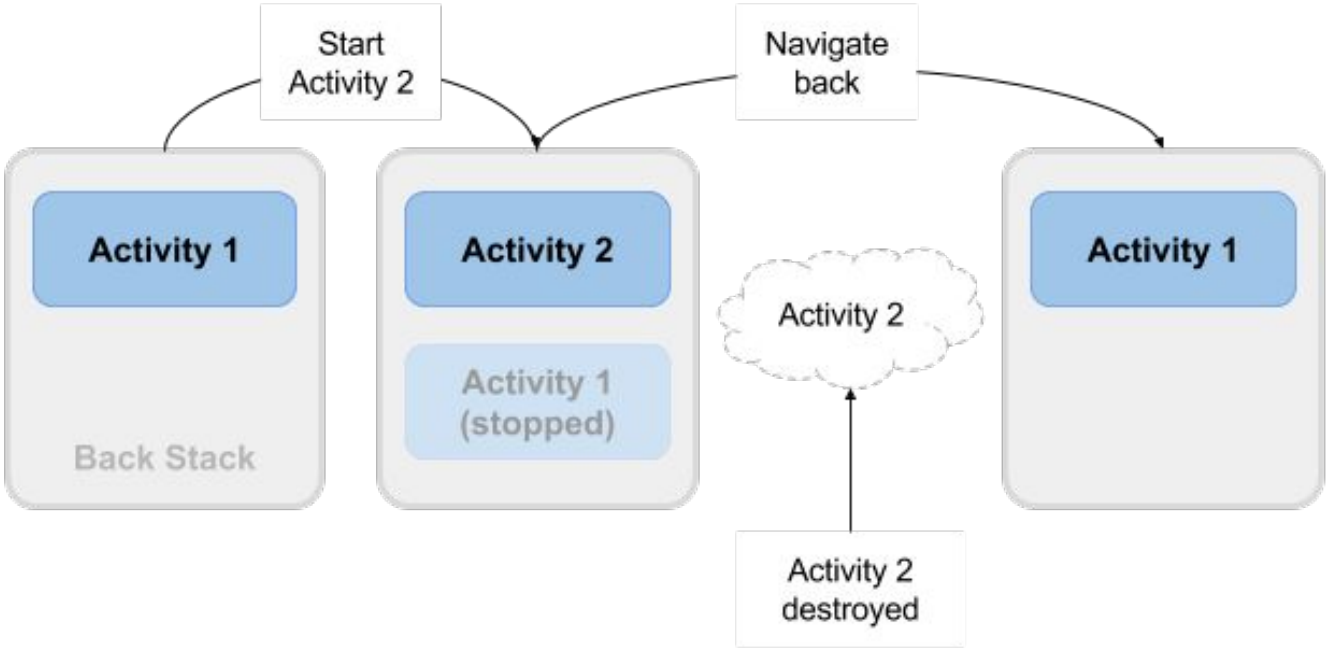
What is the Activity Lifecycle?

- The set of states an Activity can be in during its lifetime, from when it is created until it is destroyed

More formally:

- A directed graph of all the states an Activity can be in, and the callbacks associated with transitioning from each state to the next one

What is the Activity Lifecycle?



Activity states and app visibility

- Created (not visible yet)
- Started (visible)
- Resume (visible)
- Paused(partially invisible)
- Stopped (hidden)
- Destroyed (gone from memory)

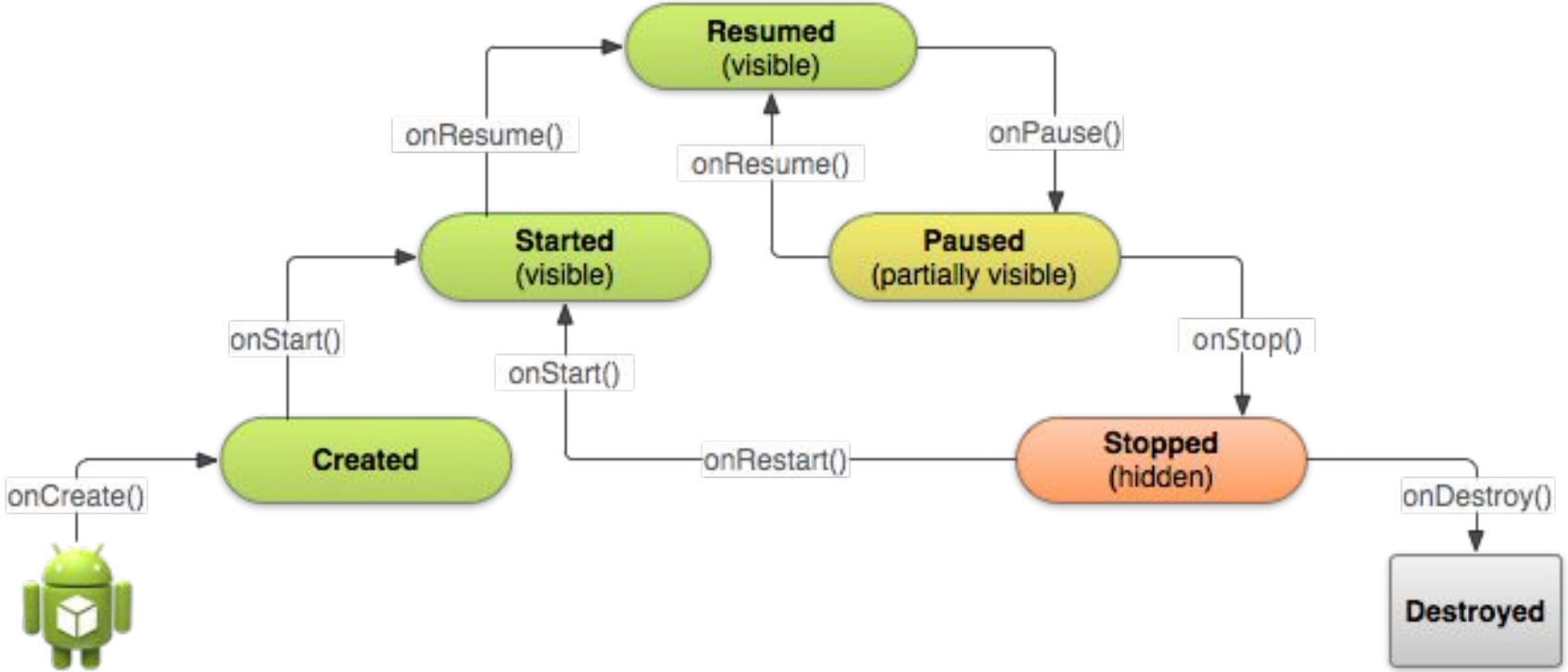
State changes are triggered by user action, configuration changes such as device rotation, or system action

Activity lifecycle callbacks

Callbacks and when they are called

- `onCreate(Bundle savedInstanceState)`—static initialization
  - `onStart()`—when Activity (screen) is becoming visible
  - `onRestart()`—called if Activity was stopped (calls onStart())
    - `onResume()`—start to interact with user
    - `onPause()`—about to resume PREVIOUS Activity
  - `onStop()`—no longer visible, but still exists and all state info preserved
- `onDestroy()`—final call before Android system destroys Activity

Activity states and callbacks graph



Implementing and overriding callbacks

- Only `onCreate()` is required
- Override the other callbacks to change default behavior

onCreate() –> Created

- Called when the `Activity` is first created, for example when user taps launcher icon
- Does all static setup: create views, bind data to lists, ...
- Only called once during an activity's lifetime
- Takes a Bundle with Activity's previously frozen state (saved with onSaveInstanceState()), if there was one
- Created state is always followed by `onStart()`

onCreate(Bundle savedInstanceState)

```
@Override
public void onCreate(Bundle savedInstanceState) {
    super.onCreate(savedInstanceState);
    // The activity is being created.
}
```

onStart() –> Started

- Called when the Activity is becoming visible to user
- Can be called more than once during lifecycle
- Followed by `onResume()` if the activity comes to the foreground, or `onStop()` if it becomes hidden

onStart()

```
@Override
protected void onStart() {
    super.onStart();
    // The activity is about to become visible.
}
```

onRestart() –> Started

- Called after Activity has been stopped, immediately before it is started again
- Transient state
- Always followed by `onStart()`

onRestart()

```
@Override
protected void onRestart() {
    super.onRestart();
    // The activity is between stopped and started.
}
```

onResume() –> Resumed/Running

- Called when `Activity` will start interacting with user
- Activity has moved to top of the Activity stack
- Starts accepting user input
- Running state
- Always followed by `onPause()`

onResume()

```
@Override
protected void onResume() {
    super.onResume();
    // The activity has become visible
    // it is now "resumed"
}
```

onPause() –> Paused

- Called when system is about to resume a previous Activity
- The Activity is partly visible but user is leaving the Activity
- Typically used to commit unsaved changes to persistent data, stop animations and anything that consumes resources
- Implementations must be fast because the next Activity is not resumed until this method returns
- Followed by either `onResume()` if the Activity returns back to the front, or `onStop()` if it becomes invisible to the user

onPause()

```
@Override
protected void onPause() {
    super.onPause();
    // Another activity is taking focus
    // this activity is about to be "paused"
}
```

onStop() –> Stopped

- Called when the Activity is no longer visible to the user
- New Activity is being started, an existing one is brought in front of this one, or this one is being destroyed
- Operations that were too heavy-weight for `onPause()`
- Followed by either `onRestart()` if Activity is coming back to interact with user, or `onDestroy()` if Activity is going away

onStop()

```
@Override
protected void onStop() {
    super.onStop();
    // The activity is no longer visible
    // it is now "stopped"
}
```

onDestroy() –> Destroyed

- Final call before Activity is destroyed
- User navigates back to previous Activity, or configuration changes
- Activity is finishing or system is destroying it to save space
- Call `isFinishing()` method to check
- System may destroy Activity without calling this, so use `onPause()` or `onStop()` to save data or state

onDestroy()

```
@Override
protected void onDestroy() {
    super.onDestroy();
    // The activity is about to be destroyed.
}
```

Activity instance state

When does config change?

Configuration changes invalidate the current layout or other resources in your activity when the user:

- Rotates the device
- Chooses different system language, so locale changes
- Enters multi-window mode (from Android 7)

What happens on config change?

On configuration change, Android:

1. Shuts down Activity by calling:
   - onPause()
   - onStop()
   - onDestroy()

2. Starts Activity over again by calling:
   - onCreate()
   - onStart()
   - onResume()

Activity instance state

- State information is created while the Activity is running, such as a counter, user text, animation progression

- State is lost when device is rotated, language changes, back-button is pressed, or the system clears memory

Saving and restoring Activity state

What the system saves

- System saves only:
  - State of views with unique ID (`android:id`) such as text entered into `EditText`
  - Intent that started activity and data in its extras

- You are responsible for saving other activity and user progress data

Saving instance state

Implement `onSaveInstanceState()` in your Activity

- Called by Android runtime when there is a possibility the Activity may be destroyed
- Saves data only for this instance of the Activity during current session
- `onSaveInstanceState` is not called when user explicitly closes the activity (e.g. presses the Back button) or when `finish()` is called. Use `onPause()` or `onStop()` instead

onSaveInstanceState(Bundle outState)

```
@Override
public void onSaveInstanceState(Bundle outState) {
    super.onSaveInstanceState(outState);

    // Add information for saving HelloToast counter
    // to the to the outState bundle
    outState.putString("count",
                String.valueOf(mShowCount.getText()));
}
```

Restoring instance state

Two ways to retrieve the saved Bundle

- in `onCreate(Bundle mySavedState)`
  Preferred, to ensure that your user interface, including any saved state, is back up and running as quickly as possible
- Implement callback (called after onStart())
  `onRestoreInstanceState(Bundle mySavedState)`

Restoring in onCreate()

```
@Override
protected void onCreate(Bundle savedInstanceState) {
    super.onCreate(savedInstanceState);
    setContentView(R.layout.activity_main);
    mShowCount = findViewById(R.id.show_count);

    if (savedInstanceState != null) {
        String count = savedInstanceState.getString("count");
        if (mShowCount != null)
            mShowCount.setText(count);
    }
}
```

onRestoreInstanceState(Bundle state)

```
@Override
public void onRestoreInstanceState (Bundle mySavedState) {
    super.onRestoreInstanceState(mySavedState);

    if (mySavedState != null) {
        String count = mySavedState.getString("count");
        if (count != null)
            mShowCount.setText(count);
    }
}
```

Instance state and app restart

When you stop and restart a new app session, the Activity instance states are lost and your activities will revert to their default appearance

If you need to save user data between app sessions, use shared preferences or a database.